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(54) **EXTREME TEMPERATURE SAFETY DEVICE FOR VEHICLES**

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(51) **Int. Cl.**

B60R 21/015	(2006.01)
G08B 21/22	(2006.01)
G08B 21/02	(2006.01)
B60H 1/00	(2006.01)
G07C 9/00	(2020.01)

(52) **U.S. Cl.**
CPC ... ***B60R 21/01534*** (2014.10); ***B60H 1/00742*** (2013.01); ***G07C 9/00896*** (2013.01); ***G08B 21/0211*** (2013.01); ***G08B 21/22*** (2013.01)

(58) **Field of Classification Search**
CPC B60R 21/01534; B60R 21/015
See application file for complete search history.

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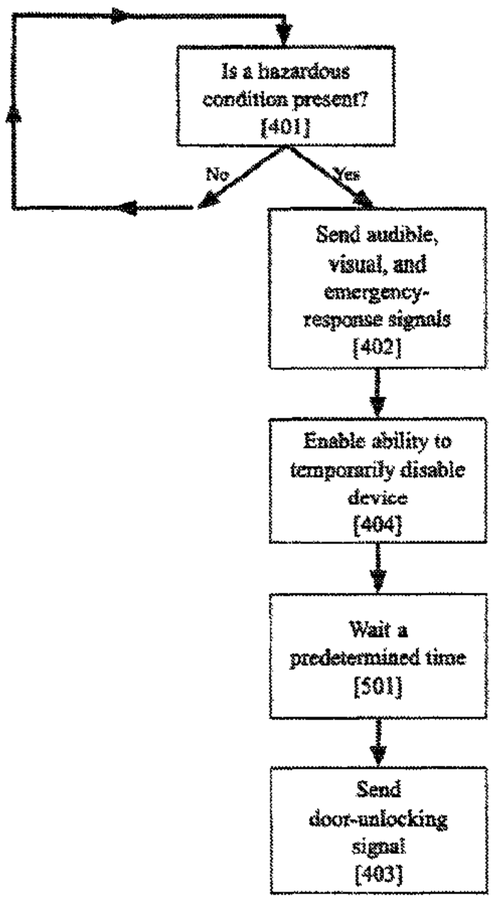
Primary Examiner — Daniel J Colilla

(57) **ABSTRACT**

An improved vehicle safety device for activating an alarm when the temperature in the interior of a vehicle reaches an extreme value. The device includes a presence sensor for detecting the presence of a human or an animal in the interior of a vehicle and a temperature sensor for detecting the temperature in the vehicle interior. A controller is coupled to the presence detector, the temperature detector, and the vehicle ignition system for generating a hazardous-condition signal in response to an extreme-temperature condition in the vehicle when a human or an animal is in the vehicle and the vehicle engine is not running. An alarm module is connected to the controller for generating audible, visual, and wireless emergency-response signals when a hazardous condition is detected. The alarm module may also be further configured to create a door-unlocking signal.

5 Claims, 4 Drawing Sheets



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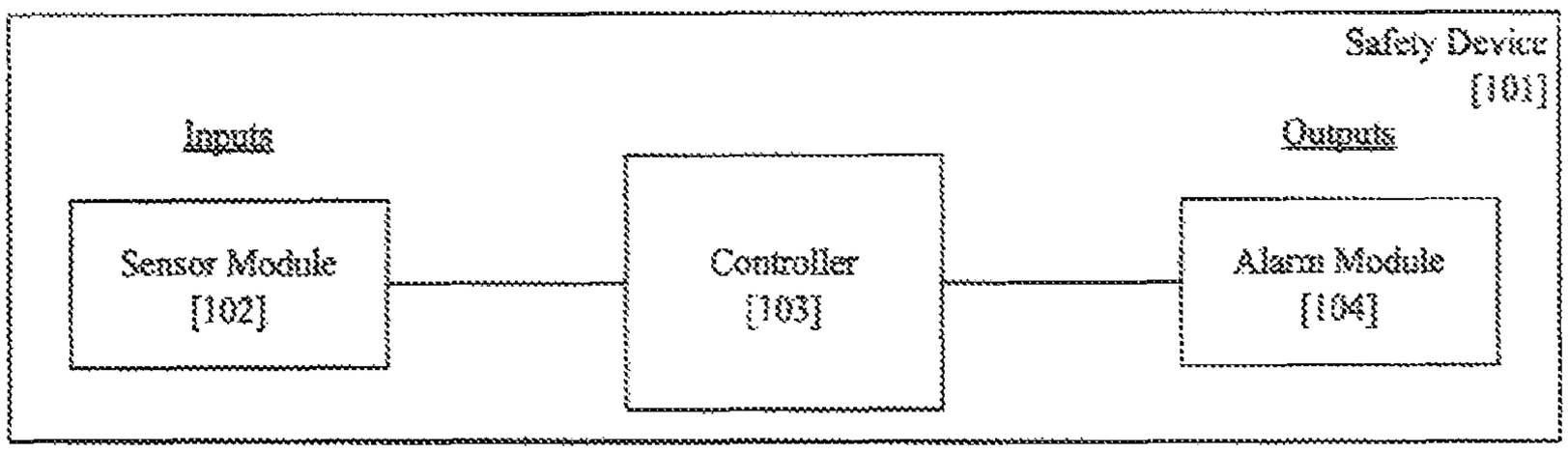

Figure 1

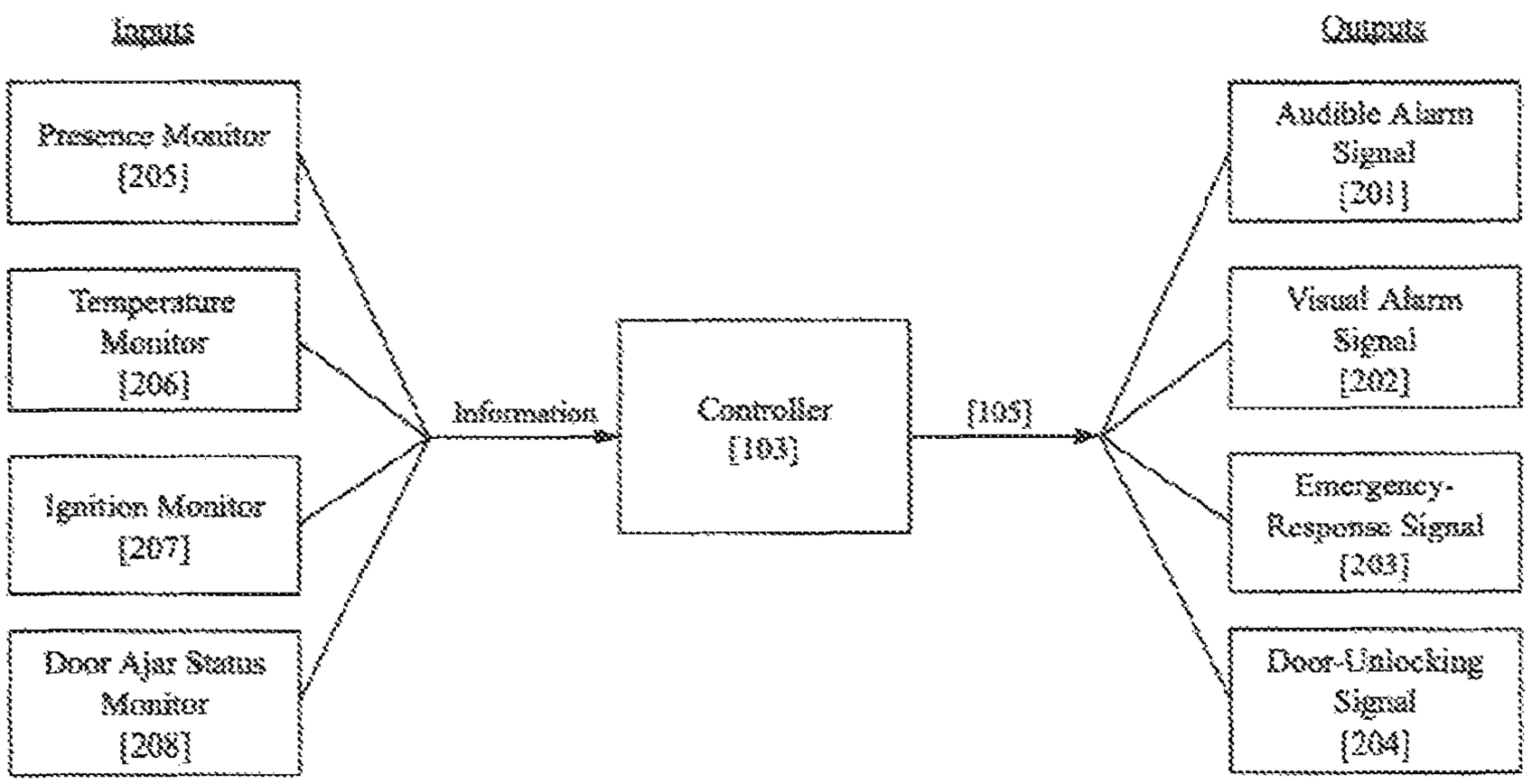

Figure 2

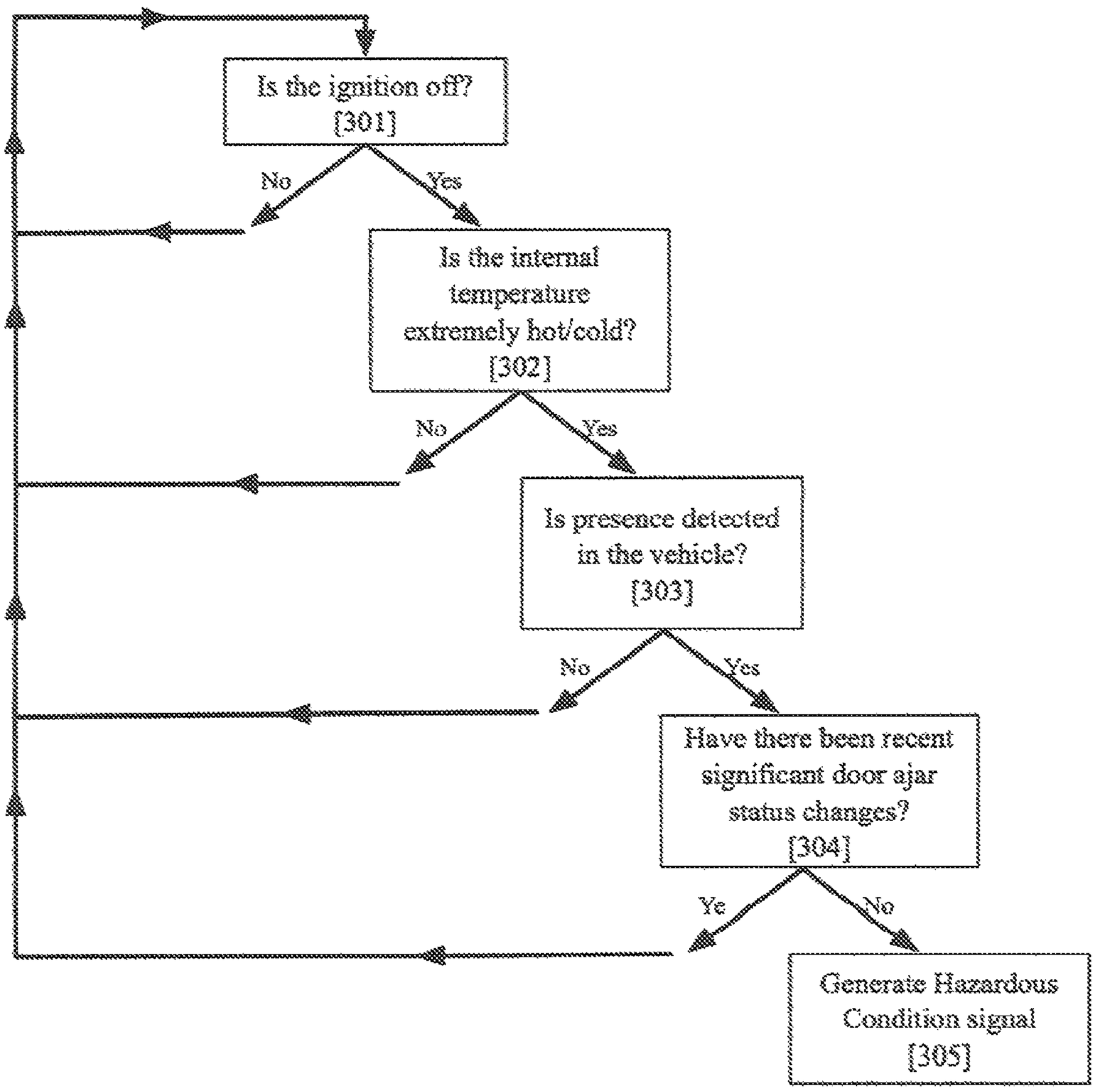
Is the ignition off?
[301]
No
Yes
Is the internal temperature extremely hot/cold?
[302]
No
Yes
Is presence detected in the vehicle?
[303]
No
Yes
Have there been recent significant door ajar status changes?
[304]
Ye
No
Generate Hazardous Condition signal
[305]

Figure 3

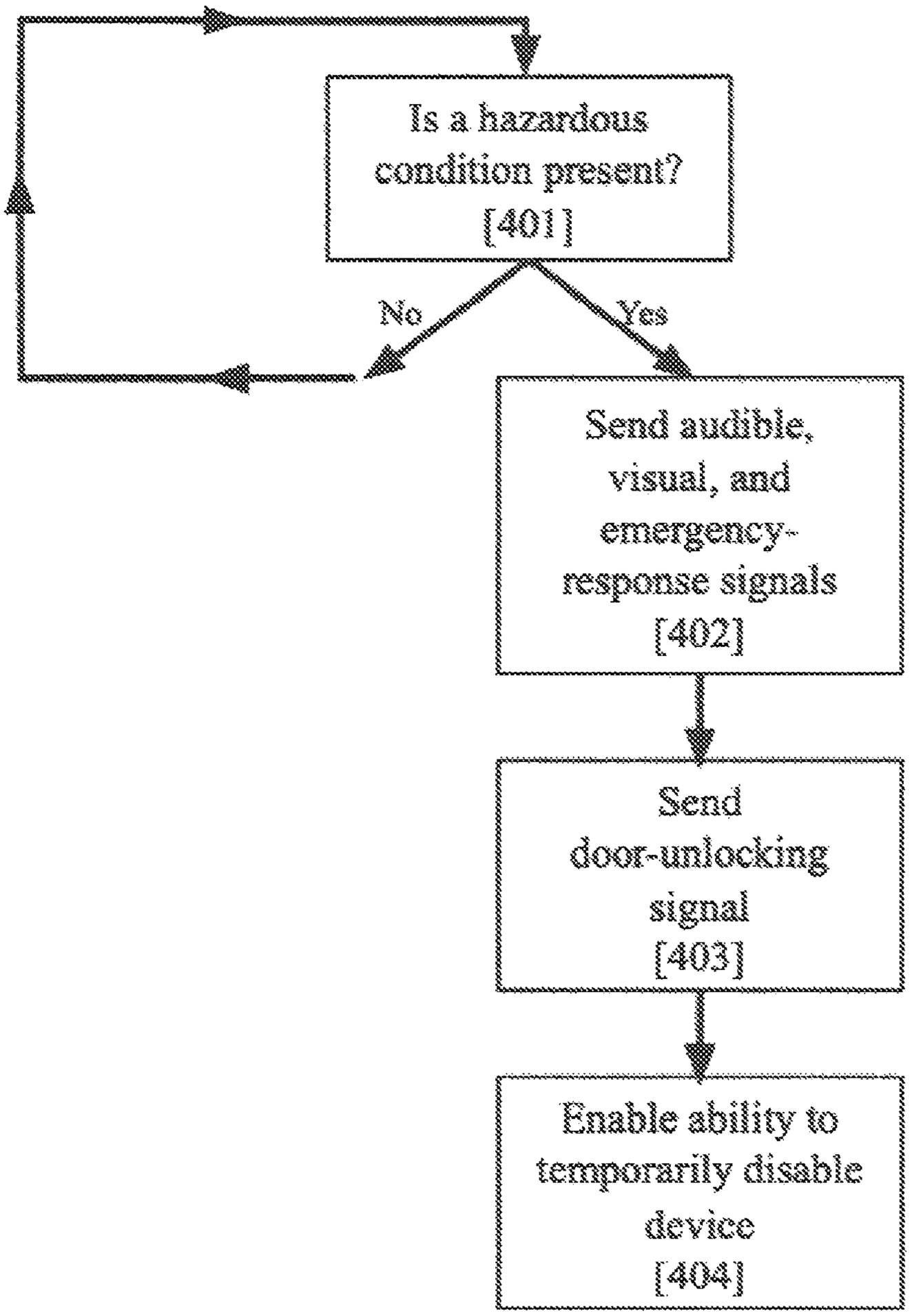
Is a hazardous condition present? [401]
No
Yes
Send audible, visual, and emergency-response signals [402]
Send door-unlocking signal [403]
Enable ability to temporarily disable device [404]

Figure 4

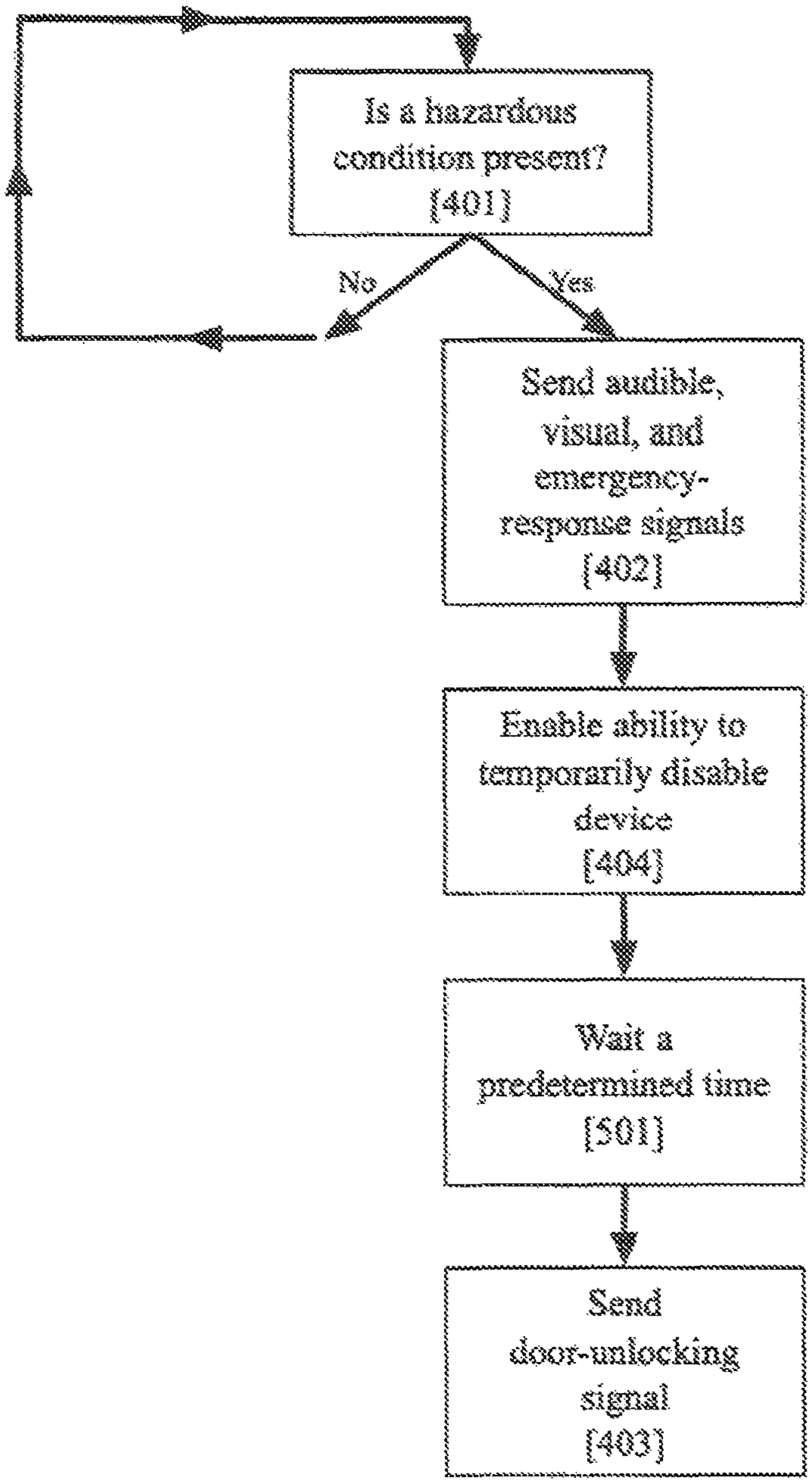
Is a hazardous condition present? [401]
No
Yes
Send audible, visual, and emergency-response signals [402]
Enable ability to temporarily disable device [404]
Wait a predetermined time [501]
Send door-unlocking signal [403]

Figure 5

EXTREME TEMPERATURE SAFETY DEVICE FOR VEHICLES

CROSS-REFERENCE TO RELATED APPLICATION

The present application claims the benefit of U.S. Provisional Patent Application Ser. No. 62/833,734, filed Apr. 14, 2019.

FIELD OF INVENTION

The present invention relates to safety devices for vehicles and more particularly to safety devices for activating an alarm when the temperature in the interior of a vehicle reaches an extreme value.

BACKGROUND OF INVENTION

Every year, children and animals die from being trapped inside of a vehicle in extreme temperature conditions. Some phone applications or sensors, such as The Backseat App or the SensorSafe Car Seat Buckle by Evenflo, remind drivers to check their backseats for a child after completing their drive. However, after repeated use, drivers may become immune to the subtle notifications of these solutions. Additionally, these solutions only account for situations for which a child or animal is accidentally left inside of a vehicle, which does not cover all of the extreme temperature related deaths in vehicles. A significant portion of the extreme temperature related deaths in vehicles result from children being intentionally left in the vehicle or gaining access to the vehicle themselves, which the previously mentioned solutions cannot limit. Consequently, a need for a safety device with the capability to limit all types of extreme temperature related deaths in vehicles arises.

Current solutions to this issue lack the consistency and accuracy of the present invention. For example, U.S. Pat. No. 9,895,955 to Quaranta-Guido describes a heatstroke preventative device in which CO.sub.2 sensors are used to detect presence inside of a vehicle by measuring the CO_2 concentration inside of the vehicle at certain locations. However, this data may be easily misconstrued if a window is opened or the vehicle's ventilation is otherwise changed.

Another problem that current devices have is their limited-alarm outputs. In the case of U.S. Pat. No. 9,381,857 to Arnold et al., the described device only sounds an audible alarm. While this may attract the attention of individuals nearby, it does nothing to notify police, medical, or fire-department personnel of an emergent situation. When nobody is in the vicinity to respond to a visual or audible alarm, notification of police, medical, or fire-department authorities may be the only way to resolve the hazardous condition.

Hence, given the significant disadvantages of the currently available heatstroke preventive devices, there is a need for a more effective apparatus to prevent death or injury from extreme temperature conditions in vehicles.

SUMMARY OF INVENTION

The principles of the present invention are embodied in a vehicle safety device, which includes a presence sensor for detecting the presence of a human or an animal in the interior of a vehicle, a temperature sensor for detecting the temperature in the vehicle interior, a controller coupled to the presence detector, the temperature detector, and the vehicle ignition system for generating a hazardous-condition signal in response to an extreme temperature condition in the vehicle when a human or animal is in the vehicle and the vehicle engine is not running, and an alarm module connected to the controller for generating audible, visual, and wireless emergency-response signals when a hazardous condition is detected. The alarm module may also be further configured to generate a door-unlocking signal.

BRIEF DESCRIPTIONS OF DRAWINGS

For a more complete understanding of the present invention, and the advantages thereof, reference is now made to the following descriptions taken in conjunction with the accompanying drawings in which:

FIG. **1** is a block diagram of the major components of the present invention.

FIG. **2** is a block diagram showing the inputs and outputs of the sensor module, controller, and the alarm module respectively.

FIG. **3** is a flow diagram of the process carried out by the controller.

FIG. **4** is a flow diagram of the process carried out by the alarm monitor.

FIG. **5** is a flow diagram of an enhanced version of the process described in FIG. **4** to thwart intruders.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is designed to reduce the number of deaths from extreme temperatures inside of vehicles by alerting surrounding individuals, the owner of the vehicle, and medical-emergency and law-enforcement authorities when there is a hazardous condition involving a child or animal inside of a dangerously hot or cold vehicle.

Referring to FIG. **1**, the safety device **101** that is the present invention contains a sensor module **102**, a controller **103**, and an alarm module **104**. The controller **103** accepts inputs from the sensor module **102** and, after processing those inputs, generates a hazardous-condition signal **105** indicative of a hazardous condition in the vehicle. Signal **105** is then further processed by the alarm module **104** which may provide a series of output signals **201**, **202**, **203**, and **204** (FIG. **2**).

As shown in FIG. **2**, the sensor module **102** may contain a presence monitor **205**, a temperature monitor **206**, an ignition monitor **207**, and a door-ajar status monitor **208**. The presence monitor **205** is preferably disposed in the interior of the vehicle and is designed to measure activity only within the interior of the vehicle. Any simple motion sensor could accomplish this role in the safety device. However, to provide more accurate readings, the presence monitor **205** should be able to detect heartbeats and respiration around or through barriers in the interior of the vehicle. A radar-based detection sensor with a frequency below 10 GHz, such as model X4M300 manufactured by XeTrhu, has proven suitable for this task. Although the radar-based detection sensor may be triggered by motion other than that of an animal or human, the controller **103** can be programmed to recognize only specific motion patterns such as breathing or a heartbeat.

The temperature monitor **206** provides information to the controller **103** indicative of the ambient temperature inside of the vehicle. The temperature monitor **206** may be any suitable temperature sensor for measuring the ambient temperature for extreme heat or cold, such as GM Part number

25775833, manufactured by General Motors Corporation. Alternatively, the temperature monitor **206** may be a bimetallic strip, a thermistor, or a thermocouple.

The ignition monitor **207** provides information to the controller **103** about the on-off status of the vehicle's ignition. Preferably, the sensor module **102** should be connected to the vehicle's CPU to access information about the state of the ignition. Alternatively, instead of hardwiring the sensor module **102** to the CPU, a zener diode or a voltage-monitoring device can be connected to a site in the vehicle that receives power regardless of the ignition state, such as a cabin light. When the ignition is turned on, the voltage will increase a measurable amount, allowing the zener diode or voltage-monitoring sensor to detect a voltage increase and provide information to the controller about ignition status.

The door-ajar status monitor **208** may also be provided to supply additional information to the controller **103** about the status of doors to prevent the triggering of false hazardous-condition signals caused by opening and closing vehicle doors. When a driver enters into an extremely hot or cold vehicle, for example, ample time needs to be given to start the ignition and to adjust the vehicle's ambient temperature to a normal level to avoid prematurely generating a false hazardous-condition signal. However, this allotted time should be no longer than 5 minutes as to avoid missing a hazardous condition. Additionally, any changes to the ajar-status of the vehicle's doors indicates activity with the vehicle. Accordingly, monitoring the opening and closing of the vehicle's doors provides the controller **103** with additional information by which signals indicative of a false hazardous condition may be filtered.

The controller's job is to define a hazardous condition when the information given by the sensor module **102** is indicative of a potentially harmful situation. These variables include: ignition turned off, extreme ambient temperature inside of the vehicle, presence inside the vehicle, and the lack of recent significant door-ajar status changes as described in FIG. **3**. If the controller **103** interprets the outputs from the sensor module **102** to be a hazardous condition through the process described in FIGS. **2** and **3**, it then sends a hazardous-condition signal **105** to the alarm module **104**.

Referring to FIGS. **1** and **2**, the alarm module **104** receives a hazardous-condition signal from the controller **103** when a hazardous condition is detected. The alarm module **104** generates four kinds of output signals: an audible alarm signal **201**, a visual alarm signal **202**, a wireless emergency-response signal **203**, and a door-unlocking signal **204**. Audible alarm signal **201** may be used, for example, to sound a car's horn or other audible alarm. Visual alarm signal **202** may be used to flash the headlights to draw attention of nearby individuals to the vehicle. Emergency-response signal **203** may be used to wirelessly transmit an emergency message to police, fire department, or emergency-trained medical personnel to notify them of a potential hazardous condition. Additionally, the emergency-response signal **203** contains information regarding the vehicle's location to aid responders in locating the vehicle. While it is preferred that people in the vicinity of the vehicle resolve the hazardous condition first, the threshold temperature may be set so that there is sufficient time for emergency personnel notified by signal **203** to respond and resolve the hazardous condition before it becomes deadly. Additionally, the controller may also generate a door-unlocking signal **204**, which will unlock the vehicle doors in an emergency situation, thereby eliminating the need to break the vehicle's windows or pry open its doors.

FIG. **3** describes the process by which inputs from sensor module **102** are processed by controller **103**. At step **301**, controller **103** determines whether, based on a signal (or lack of a signal) from ignition monitor **207**, the ignition is on or off. If the ignition is off, controller **103** determines whether, based on information from temperature monitor **206**, an extreme temperature condition exists. If so, at step **303**, controller **103** next determines whether a human or an animal is in the vehicle based on input from presence monitor **205**. If a person or animal has been determined to be present in the vehicle, then, at step **304**, the controller determines, from door-ajar status monitor **208**, whether any doors of the vehicle have been opened or closed within a specified time. If all hazardous-condition criteria are satisfied, controller **103** determines that a hazardous condition is present at step **305** and sends a hazardous-condition signal **105** to alarm module **104**.

Once a hazardous condition has been determined to be present, a button or switch in the vehicle (not shown) can be activated to temporarily disable the safety device **101** to allow the condition to be resolved and the device to be rearmed. This will ensure ample time for the variables of the hazardous condition to return to their normal state before the alarm module **104** can be re-activated to reduce the probability of a double trigger for a single hazardous situation. However, this period must not be longer than a half an hour to avoid missing a real hazardous situation.

FIG. **4** describes an embodiment in which one or more signals may be sent from the alarm module. Once the hazardous-condition signal **105** is received by the alarm module **104**, one or more of the audible, visual, or emergency-response signals are sent at step **402**. A door-unlocking signal **204** may also be sent at step **403**. In addition, at step **404**, the device may be manually disabled for a predetermined time by activating a button or switch inside the vehicle to allow detected conditions to return to normal.

FIG. **5** shows an alternative process for generating alarm signals in a way that thwarts unwanted interference with the door-unlocking mechanism. The process described in FIG. **5** generally follows the flow of the process shown in FIG. **4** except that the alternative process interposes a delay at step **501** (after the audible, visual, and emergency-response signals are sent) before the door-unlocking signal is generated at step **403** to unlock the doors. This delay is designed to provide ample time for the audible, visual, and transmittable signals to attract enough attention to the vehicle before an unwanted intruder can open the unlocked doors.

Although the invention has been described with reference to specific embodiments, these descriptions are not meant to be construed in a limiting sense. Various modifications of the disclosed embodiments, as well as alternative embodiments of the invention, will become apparent to persons skilled in the art upon reference to the description of the invention. It should be appreciated by those skilled in the art that the concept and the specific embodiment disclosed might be readily utilized as a basis for modifying or designing other structures for carrying out the same purposes of the present invention. It should also be realized by those skilled in the art that such equivalent constructions do not depart from the spirit and scope of the invention as set forth in the appended claims.

It is therefore contemplated that the claims will cover any such modifications or embodiments that fall within the true scope of the invention.

The invention claimed is:

1. A safety device for a vehicle, comprising:

a presence monitor disposed in the interior of the vehicle for detecting a presence of a human or an animal in an interior of the vehicle;

a temperature monitor disposed in the interior of the vehicle for detecting temperature in the interior of the vehicle;

a controller coupled to the presence monitor, to the temperature monitor, and to an ignition system of the vehicle for generating a hazardous-condition signal in response to an extreme temperature condition in the vehicle when a human or animal is detected in the vehicle and the vehicle engine is not running; and

an alarm module connected to the controller for generating an audible alarm signal, a visual alarm signal and a wireless emergency-response signal in response to a hazardous-condition signal from the controller,

wherein the alarm module is configured to generate a door unlocking signal to unlock doors of the vehicle a redetermined time after the audible, visual, and emergency-response alarm signals have been sent.

2. The device of claim **1** wherein the presence monitor is a radar-based detection sensor.

3. The device of claim **1** wherein the presence monitor is a heartbeat detection sensor.

4. The device of claim **1** further comprising a door monitoring system disposed in the interior of the vehicle for detecting the opening of the vehicle doors.

5. The device of claim **1** further comprising a switch mounted in the interior of the vehicle for disabling the alarm module when the hazardous condition has been resolved.

* * * * *